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IS 8651 (1977): Flame Photometer [PGD 22: Educational Instruments and Equipment]



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IS : 8651 - 1977

Indian Standard

SPECIFICATION FOR FLAME PHOTOMETER

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SPECIFICATION FOR FLAME PHOTOMETER

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Indian Standard

SPECIFICATION FOR FLAME PHOTOMETER

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 29 November 1977, after the draft finalized by the Optical and Mathematical Instruments Sectional Committee had been approved by the Mechanical Engineering Division Council.

0.2 Flame photometer is essentially employed for determination of concentration of sodium, potassium, calcium and lithium in body fluids, like urine, plasma, etc. It is an indispensable tool in the analytical laboratory for medicine, biochemistry, soil science, fertilizer industry, glass and ceramic industry and ground water analysis.

0.3 The working principle of the instrument is that a portion of the solution under test is atomized into fine spray and burnt in flame, under controlled conditions, emitting spectral lines or band characteristics of different elements which are present in the solution. A characteristic spectral line for a given element is selected out by a suitable filter and converted into electric current by a photo-electric cell. The current indicated on a meter which is pre-calibrated, is a measure of the concentration of the element present in the solution. This standard covers flame photometers for the determination of sodium, potassium and calcium. Filters for the estimation of these three elements are necessary. Any other filters/accessories required for evaluation of other elements shall be by agreement between the manufacturer and the purchaser.

0.4 Flame photometer consists of a pressure regulator, flowmeters for the fuel gases, atomizer, burner, optical system, photoelectric device and instrument for indicating or recording the output. The function of the optical system is to collect the light from the steadiest part of the flame and pass it through the appropriate filter to the detector. A uniform illumination on the detector is essential. It is important to focus the mirrors and lenses so that light is distributed over the entire surface of the detector. A schematic diagram of the flame photometer is shown in Fig. 1.

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960*.

*Rules for rounding off numerical values (*revised*).

The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard covers the general and functional requirements of the flame photometer.

2. TERMINOLOGY

2.0 For the purpose of this standard, some of the definitions given in IS : 1399-1959* and the following shall apply.

2.1 Atomizer — It is a device which produces aerosol by dispersion of the liquid sample into very small droplets by means of compressed air, oxygen, etc.

2.2 Narrow-Band Pass Filter — It transmits light over a spectral band of finite width but rejects light over the spectrum on either side of the band.

2.3 Photoelectric Cell — It transforms the light flux into electric current.

2.4 Detector Amplifier — It amplifies the electrical signal from the photocell to a magnitude that can be read on an instrument dial or recorded.

2.5 Sensitivity (Limit Concentration) — It is defined for each element by the smallest quantity of the element that can be identified under certain experimental conditions; and is expressed in units of parts per million.

2.6 Mixing Chamber — It ensures a close and homogeneous mixture of the fuel, air and the aerosol before or at the very moment when they reach the atmosphere to produce the flame.

3. GENERAL REQUIREMENTS

3.1 The instrument shall be of portable type of minimum dimensions and weight.

3.2 The optical system of flame photometer shall conform to the requirements laid down in IS : 988-1959† and IS : 2754-1964‡.

3.3 Housing — The instrument cover shall be removable and rigid. It shall be provided with windows at suitable places for easy access to inner components which need frequent attention.

*Glossary of terms used in optical technology.

†General requirements for optical components.

‡General requirements for optical instruments.

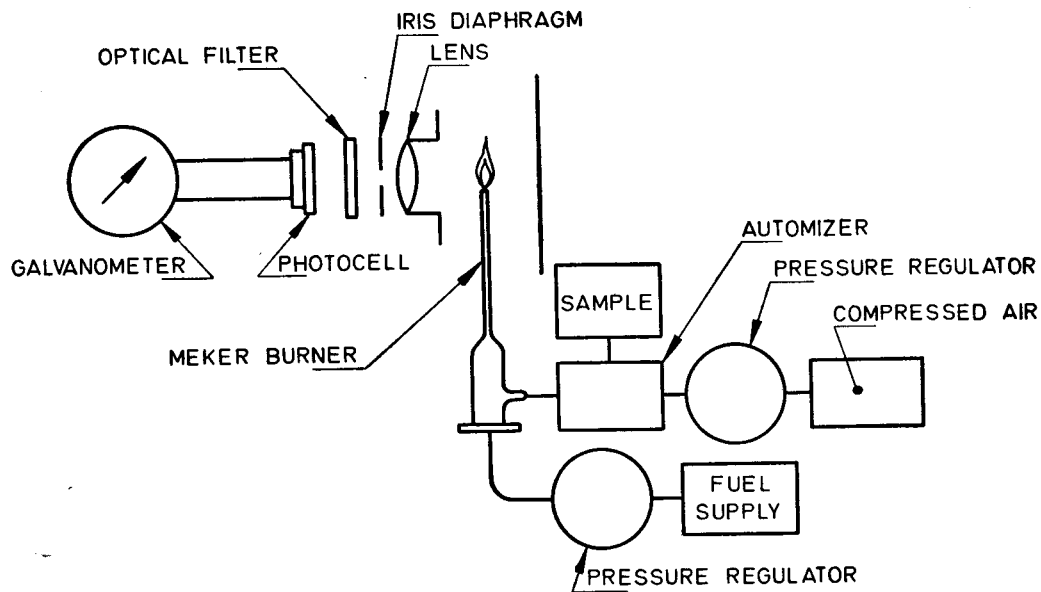


FIG. 1 SCHEMATIC DIAGRAM OF FLAME PHOTOMETER

3.4 Burner — The burner shall be detachable for cleaning and washing so as to remove all contamination.

3.5 Atomizer — The material of construction shall be of non-corrosive type and it should be easily detachable from the main body. All its parts shall be accessible for cleaning. An extra interchangeable atomizer unit is also recommended to accommodate samples of varying viscosity and surface tension to be supplied with the instrument. Interchangeable nozzles with different orifices shall also be supplied with the atomizer.

3.6 Pressure Gauge — The pressure gauge shall be a direct reading dial pattern with graduation in kPa. The scale shall be marked with a single red line showing the maximum pressure beyond which the instrument shall not be worked. This pressure should preferably be 70 kPa. The range of the pressure gauge should preferably be 0 to 140 kPa with suitable sub-divisions marked. The gauge shall be fitted on front side of the panel for convenient reading.

3.7 Detector Amplifier — All the electronic components shall be selected and conservatively rated. The method of mounting these components shall be such as to avoid all possible leakage of current. Values of different components used in the resulting system shall be indicated and a circuit diagram supplied with the instrument.

3.8 Combustion Fuel — Domestic gas cylinder or any other fuel gas system, fitted with arrangement for controlling rate of flow of gas, may be used for the purpose. The gas inlet and air inlet into the instrument shall be properly marked.

3.9 Compressor — Compressor working on 220 volts ac and fitted with a suitable pressure regulating device shall be used. The compressor shall be capable of providing oil free air at optimum pressure of 100 kPa. It shall be provided with a small buffer reservoir so as to give a steady supply of compressed air at a constant pressure. The mechanical mounting of the compressor-motor assembly shall be reasonably silent and vibration free.

3.10 The optical glass shall conform to IS : 1400-1960*.

3.11 The rotation of knobs for regulating the flow of gas, air and filament ignition system shall be smooth and fine, and the direction of rotation properly indicated.

*Specification for optical glass.

3.12 The filters shall be clearly marked as Na, K and Ca as applicable.

3.13 The manufacturer shall furnish the following details about the instrument for the guidance of the purchaser:

- a) Optical system employed,
- b) Types of filters supplied,
- c) Dimensions and weight of the instrument and air compressor, and
- d) Availability of extra filters and accessories.

4. FUNCTIONAL REQUIREMENTS

4.1 The capillary of atomizer shall be of such diameter that the air while flowing into chamber draws in the liquid and atomizes it into a fine spray. Any amount of excess liquid which remains unsprayed by the atomizer shall drain out from the mixing chamber.

4.1.1 It shall be adjustable to permit varying rates of spray and once adjusted shall introduce the sample at a stable and reproducible rate of spray.

4.2 The flow of gas and air into the mixing chamber shall be controllable with fine controls and the mixing shall be thorough.

4.3 When fitted with an automatic ignition system, the knob for ignition of the filament shall automatically switch off the current when the flame ignites and shall swing out of the field of view.

4.4 The filters used for the analysis of sodium, potassium and calcium shall have a peak transmission at 589 ± 3 nm; 763 ± 3 nm; 625 ± 3 nm or 423 ± 3 nm respectively. The filters supplied for the analysis of calcium may have one of the two values specified depending upon the design and calibration of the instrument. Half band width of the filters shall be 8 to 20 nm and peak transmission shall be more than 35 percent.

4.4.1 The filters shall be suitably mounted on a rotating drum for actuating from outside. An aperture control device shall also be provided in between the condensing system and the filter to control the intensity of light falling on the photocell. Two free apertures shall be provided on the drum to take additional filters.

4.4.2 On rotating the drum fitted with filters, the filters shall come in correct alignment with the condenser and aperture and the drum shall click at the proper positioning of filters. The motion of the drum shall be smooth.

4.5 The photo-electric dc amplifier, if provided, shall meet the following requirements:

- a) The power supply to the amplifier shall be stabilized, and
- b) The resulting response shall be linear for simplification in calibration.

4.5.1 Arrangement for zero setting of the pointer on the scale and its 100 percent calibration shall be provided.

4.6 Sensitivity — The sensitivity of the instrument shall be variable over a wide range as under:

<i>Element</i>	<i>Sensitivity Range for Full Scale Deflection (100 Division), in ppm</i>
Na	1 to 10
K	2 to 20
Ca	10 to 100

4.7 Accuracy — The measurements of the elements concentration shall be accurate to within ± 5 percent of true value.

5. TESTS

5.1 The instrument shall be tested for the general finish, scratches, loose screws, nuts and bolts, defined lettering and for the smooth operations of the various knobs.

5.2 It shall be possible to adjust the size and shape of the flame such that it covers the entire area of the optical path.

5.3 The optical components including the filters shall be clean and free from dust, grease, scratches and any other foreign matter.

5.4 The capillary shall be clean and shall be able to suck the liquid continuously. The rate of sucking shall be uniform.

5.5 The spray from the nozzle shall be even and shall not condense the liquid immediately after the nozzle.

5.6 The gas pressure regulator shall be such that it is able to maintain and feed the flame which shall remain steady and constant in area (extent) during the entire period of operation.

5.7 The liquid shall be sprayed with a constant pressure of about 70 to 100 kPa.

5.8 With the aid of the set zero knob it shall be possible to bring the meter needle to zero when distilled water is injected into the flame.

5.9 The sensitivity knob shall function evenly and uniformly.

5.10 The pump shall deliver a uniform pressure as desired but not more than 140 kPa.

5.11 When the instrument is tested with solutions of different ppm (concentrations), the deflection in the meter (meter reading) shall be related to the ppm (concentration) of the solutions, at lower concentrations.

5.11.1 The standard solution for sodium, potassium and calcium may be prepared as under:

- a) *Sodium solution* — Dissolve 2.542 g of analytical grade of NaCl in one litre of distilled water in a volumetric flask. This gives 1 000 ppm solution which may be further diluted to give the desired ppm value.
- b) *Potassium solution* — Dissolve 1.909 g of analytical grade of KCl in one litre of distilled water. This gives 1 000 ppm solution which may be further diluted to give the desired ppm value.
- c) *Calcium solution* — Dissolve 2.497 g of analytical grade of CaCO_3 in a small quantity of dilute HCl and dilute it to one litre. This gives 1 000 ppm solution which may be further diluted to give the desired ppm value.

5.12 When distilled water is injected into the flame, the flame shall be blue and shall not exhibit any other colour.

6. MARKING

6.1 Each flame photometer shall be marked at a suitable place with the manufacturer's name or trade-mark, serial/batch number and its year of manufacture.

6.1.1 The instrument may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

7. PACKING AND PACKAGING

7.1 The flame photometer shall be delivered in a thoroughly clean and dry condition.

7.2 The filters, condenser, photocell and mirror shall be wrapped in a clear, dry and acid-free tissue paper and shall be suitably retained in position.

7.3 Silica gel shall be suitably placed in the packing cases.

7.4 The unit shall be supplied with all detachable parts packed in separate wooden cases. These cases shall be screwed with internal stops provided wherever necessary. All possible care shall be taken in packing different parts in cardboard or wooden containers with paddings to absorb shocks in transit.

7.5 Compressor unit shall be packed separately in a strong wooden case, screwed and provided with handle.

7.6 The case along with handle shall be locked during transit and keys attached to the handle.

7.7 The package shall be marked with the description, number of contents, the standard symbol for indicating fragile contents, the symbol 'THIS WAY UP' and the legend 'INSTRUMENT, HANDLE WITH CARE' in red according to IS : 1260 (Part II)-1973*.

*Pictorial markings for handling and labelling of goods : Part II General goods (first revision).

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INDIAN STANDARDS

ON

OPTICAL INSTRUMENTS

IS:

- 988-1959 General requirements for optical components
- 1399-1959 Glossary of terms used in optical technology
- 1400-1960 Optical glass
- 2352-1963 Procedure for basic climatic and durability test for optical instruments
- 2754-1964 General requirements for optical instruments
- 3081-1965 Dimensions and marking of general purposes microscopes
- 3099-1965 Slides and cover slips for microscopes
- 3113-1965 Prismatic binoculars for common use
- 3135-1965 Cathetometer
- 3602-1966 Recommendations for the design of scales and indexes for indicating instruments for scales of 1 to 2 percent resolution
- 3686-1966 Student type microscope
- 4328-1967 Monocular dissecting microscope
- 4329-1967 Measuring (travelling) microscope
- 4381-1967 Pathological microscope
- 4382-1967 Non-tinted ophthalmic glass
- 5148-1969 Hand magnifiers (circular) 50 mm, 75 mm and 100 mm
- 5204-1969 Research microscope
- 5695-1970 Spectacle lenses
- 5920-1970 Recommendations for the preparation of drawings for optical elements and systems
- 6425-1971 Dioptrimeter (lensometer)
- 6471-1971 Spectrometer (student type)
- 6472-1971 General requirements for tinted ophthalmic glass
- 6473-1972 Trial spectacle lens sets
- 7545-1975 Optical bench (advanced type)
- 7919-1975 Refractrometer — Abbe' type
- 8260 (Part I)-1976 Glossary of terms relating to ophthalmic lenses and spectacle frames: Part I Ophthalmic lenses
- 8260 (Part I)-1976 Glossary of terms relating to ophthalmic lenses and spectacle frames: Part II Spectacle frames
- 8275-1976 Binocular eyepieces for microscope